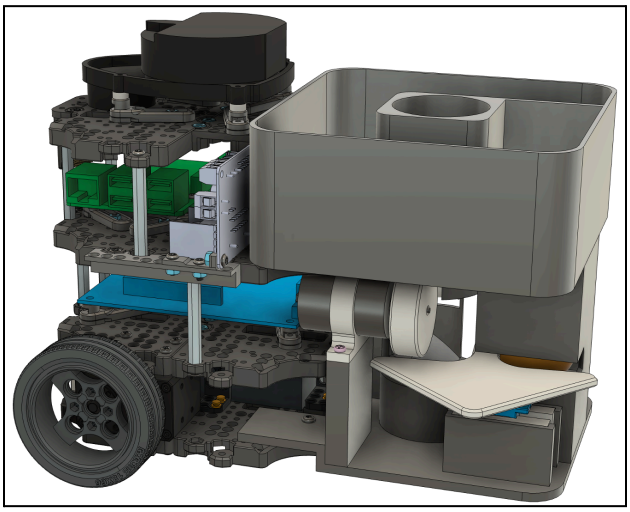
End User Documentation



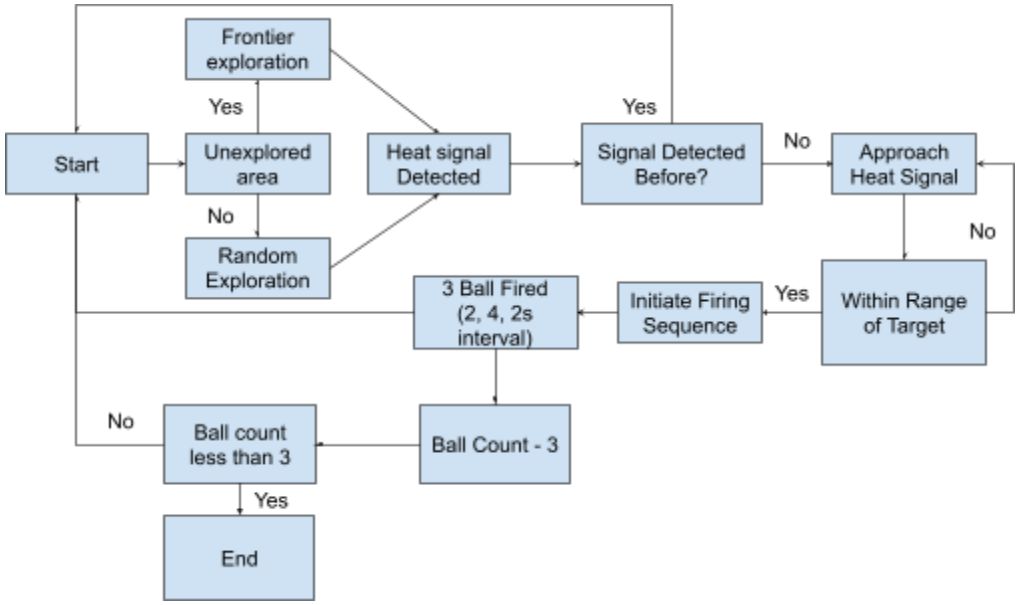
Part I: General System Description & Critical Data (Spec Sheet)

System Purpose:
The purpose of the search and rescue robot is to autonomously navigate and map complex maze-like environments while actively searching for heat signatures that indicate the presence of humans. Using LiDAR sensor and navigation algorithms, the robot efficiently traverses obstacles and gathers real-time spatial data. Once a heat signature is detected, the robot maneuvers closer to the source to ascertain its location accurately. Once close enough, it deploys ping pong balls representing flares.

System Specifications:

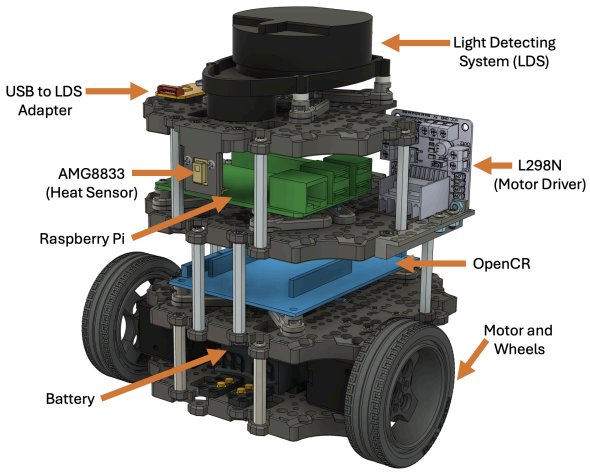
Specification	Description
Model	Turtlebot3 Burger
Software Version	ROS2, Ignition Gazebo Fortress
Weight (g)	Max1394g
Center of Mass	X-axis: 8.84cm, Y-axis: 9.23cm, Z-axis: 8.03cm
Sensors	AMG8833, LiDAR 2.0
Actuators	Servo motor, L298N Motor Driver, 12V RS-3835 Motor
Battery Capacity	1800mAh
Ball Capacity	16
Operating Time	2hr 8mins
Firing Height	2m
Max Speed	0.21m/s

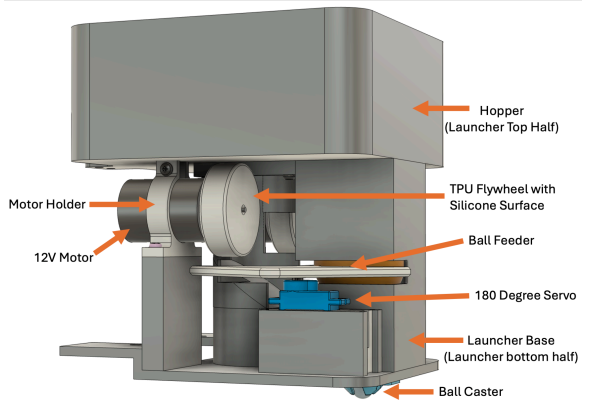
Software Block Diagram



Part II: Technical Guide

Components	Quantity
LiDAR LDS	1
USB to LDS Adapter	1
AMG8833	1
Raspberry Pi 4	1
L298N Motor Driver	1
OpenCR	1
Dynamixel Motor	2
LiPO 1800mAh Battery	1
Hopper	1
Launcher Base	1
TPU Flywheel	2
Ball Feeder	1
12V Motor and Mount	2
Servo Motor	1





Getting Started

Step	Details
1	Shake the bot gently to ensure all components are securely fastened
2	Turn on the turtlebot using the switch on the OpenCR
3	Ensure that the LiDAR LDS spinning, musical chime is heard, L298N and RPi flashing
4	Fill Hopper with 9 Ping Pong Balls
5	Using a remote PC, connect to the turtlebot's RPi
6	Place the bot into the search and rescue site
7	Run "remote computer robot_fsm_launch.py" on the remote PC
8	Run "Raspberry pi cde2310_launch.py" on the RPi
9	Refer to Software Block Diagram and verify operation as expected

Firing Mechanism

1. Flywheels start spinning
2. Ball Feeder feeds balls into Flywheel, at 2 sec, 4sec and 2sec intervals and the ball is launched upwards.
3. Ball contained within Hopper is fed into Launcher Base.

Part III: Acceptable Defect Log

Defect Description	Defect Classification		
	Critical	Major	Minor
Supporting material could not be removed completely			✔
Walls of printed part not entirely smooth			✔
Misaligned AMG8833 mount holes			✔
Slight peeling of black silicone layer on flywheel		✔	

Part IV: Factory Acceptance Test

Subsystem	Description	Procedure	Acceptance Criteria	Results
Software	Startup procedure on laptop is complete	1) Run ‘rslam’ in the command line 2) Run ‘rteleop’ and input ‘w’	1) An occupancy grid is visible (walls are marked black and unexplored space is marked in white) 2) Verify that the robot is moving forward	
Mechanical	Nuts and screws are secured tightly	1) Individually tighten each nut and screw with a screwdriver 2) Gently shake the robot to ensure there are no loose parts	1) Nuts and screws are tightened to the maximum	
	Sufficient clearance space between moving components	1) Insert 5 ping pong balls into the firing funnel 2) Manually turn the ball feeder	1) All 9 ping pong balls can move out of the funnel 2) The ball feeder does not touch the flywheel	
	Silicone around the flywheel is not peeling	1) Visual check all around	1) The entire circumference is covered in silicone with	
	Silicone around flywheel fully cured	1) Touch every part of the flywheels	1) Every part of the flywheel is dry	
	Hopper of the launching mechanism effectively feeds balls into the hole	1) Place a ping pong ball on the surface of the slope and release it without exerting any force on the ball. Repeat for each corner of the hopper	1) Ping pong ball should roll down into the hole 100% of the time	
Electrical	Wires should be	1) Check that every	1) There should be 3	

	connected securely	wire is connected 2) No wires should have loose ends	wires connecting to the servo motor 2) Ensure that the Vin and Gnd are screwed tightly on the motor driver using a screwdriver 3) There should be 6 wires that are connected to the AMG8833 4) Check that the Vin and Gnd connections are properly insulated	

Part V: Maintenance and Part Replacement Log

Defect Date	Description	Rectification	Close Date
18 Mar 2025	Hopper of the launch mechanism had too gentle of a slope, causing ping pong ball to be stuck in some rare instances	Increased the angle of the slope and reprinted the hopper	1 Apr 2025
18 Mar 2025	Base of launch mechanism had screw holes that were too small, preventing proper assembly onto the turtle bot	Changed the position of the screw holes and increased the size before reprinting the part	1 Apr 2025
3 April 2025	Silicone on flywheel peels off after some usage	Applied the silicone onto the new wheels such that it covered the entire wheel rather than just the circumference	8 Apr 2025
6 Feb 2025	RPi burnt after supplying excess power into it via a portable power source.	Replaced the RPi one for one after writing a reflection	7 Feb 2025